D-3

JOINT VENTURE MOA

CORRESPONDENCE AND GUIDELINES

Gaines, Roger A MVM

From: Maynord, Stephen T WES01
Sent: Tuesday, March 16, 1999 1:25 PM
To: Gaines, Roger A MVM
Subject: r&D write-up

Follow Up Flag: Follow up
Due By: Tuesday, March 23, 1999 1:34 PM
Flag Status: Flagged

This writeup is quite similar to your time line. The primary difference is that the effort on the comparative analysis goes on in earnest while you are at school. Let me know what you think.

steve

PROGRAM Inland Navigation

WORK UNIT # NEW

WORK UNIT TITLE Micro-model Evaluation for Navigation Channel Design

PERFORMING LAB: WES PRINCIPLE INV S.T. MAYNORD
R.A. GAINES
R.D. DAVINROY

ADDRESS 3909 Halls Ferry Road
Vicksburg, MS 39180-6199

PROBLEM
The micro-model is a new, extremely small scale, physical, sediment model. The micromodel differs from traditional movable bed sediment models primarily in it small size but yields quick, inexpensive, visual results. Because it is only used within the Corps and because it has large potential for use within and outside the Corps, an independent evaluation is needed.

OBJECTIVE
Compare micromodel to prototype bathemetry data to determine capabilities and limitations relative to channel shape and channel forming processes in response to dikes, weirs or other changes in the channel.

DESCRIPTION
Previous movable bed models from WES and other agencies/universities will be compared to determine agreement of large scale movable bed studies with prototype data. Comparison techniques will have to be developed and can include comparison of thalweg position, areas of scour and deposition, and bed elevations. The same comparison techniques will be used to evaluate previous micromodel studies. Two new micromodel investigations will be conducted at the normal size micromodel and two times larger micromodel of the Kate Aubrey reach of the Mississippi River where data exists before changes (dikes) were added to the prototype and data exists after the river had sufficient time to respond to changes. The same comparison techniques developed previously will be used to compare the two new micromodels to the prototype data. Particular emphasis in the evaluation will be given to those comparisons where prototype data exists after prototype changes have had sufficient time to respond.

BENEFIT
By defining the capabilities and limitations of the micromodel, the model can be used throughout the Corps and outside the Corps.

ACCOMPLISHMENTS
None. Proposed Work Unit.

MILESTONES

TITLE	SCHED	RESCD	COMP
Complete Kate Aubrey MM at traditional MM scale using low flow prototype data	9909		
Complete Kate Aubrey MM at twice traditional MM scale using low and high flow prototype data	0009		
Complete comparative analysis of previous movable bed models	0009		
Complete Kate Aubrey MM at traditional MM scale using high flow prototype data	0012		
Complete comparative analysis of Kate Aubrey models and any other MM results that allow comparison with prototype data after changes made.	0104		
TR of all results and Journal paper	0109		

TECHNOLOGY TRANSFER

Non-Mission Related Technology Transfer Potential- An application assessment of the potential for successful transfer of the technology or data resulting from this work unit to state and local governments and to private industry in accordance with Public Law 96-480, has been performed. The assessment indicates that a product resulting from this work unit has high potential for non-mission technology transfer.

FUNDING	PRIOR YEARS	FY00	FY01	FY02	FY03	FY04	TO COMPL	TOTAL
IN-HOUSE	0	230	100	0	0	0	0	330
CONTRACTUAL	0	20	20	0	0	0	0	40
TOTAL	0	250	120	0	0	0	0	370

file micro.r&d

CEMVM-ED-H 28 April 2003

MEMORANDUM THRU

CEMVM-ED
CEMVM-DE

MEMORANDUM FOR

CEMVD-TD-TW

SUBJECT: Micromodel Evaluation Executive Summary of Joint Venture Team Findings

1. Reference Memorandum of Agreement dated 7 April 1999 between CEMVM-ED-H, CEMVS-ED-H, CEWES-CR, and CEMVD-ET-E outlining a scope of work for the study of "Micromodel Capabilities and Expanded Applications." The MOA established a Joint Venture team and associated Technical Advisors from each respective office to conduct the investigation.

2. The Joint Venture represents an investment of significant resources over the previous four years. Although many issues were investigated and debated at length during the course of the research effort, some disagreement between the principal investigators remains on appropriate uses for the micromodel methodology. Over the past 12-18 months, the three principal investigators, in consultation with the team of technical advisors, met numerous times to discuss possible consensus points regarding several main issues. To date, these issues have not been resolved to form a consensus from the investigating team.

3. The principal investigators and the technical advisors meet on November 18 and 19, 2002 to establish a course of action to report the current understanding of "Micromodel Capabilities and Expanded Applications." The course of action included the preparation of executive summaries by each of the three principal investigators. These separate executive summaries were then to be combined into a single consolidated report, which would be forwarded to MVD for review. A date of March 1, 2003 was set for the completion of the consolidated report. As of March 1, 2003, only two of the three individual executive summaries were prepared, by MVM and MVS. The third executive summary, from ERDC, was not completed because of concerns regarding the reporting content and format that was developed during the November 18 and 19, 2002 meeting. Discussions between the team between March 1, 2003 and the present have not resulted in any progress toward reaching a consolidated report.

4. In an effort to bring this evaluation to a point of closure, the MVM and MVS summaries have been combined into a single document. Because ERDC has not provided a summary stating positions held as described at the November 18/19, 2002 meeting, the MVM and MVS combined document is being forwarded to MVD without due consideration of ERDC input. For this reason, MVD should review the combined MVM and MVS document with the understanding that ERDC dissents to the content thereof.

Comments on Scope of Work:

1. I don't know where we should state this but several places in this write-up and in the earlier draft had the statement that we are addressing the full capabilities of the micro-model. This SOW only evaluates the ability of the model to reproduce channel forming processes in response to dikes, weirs, etc. We are not evaluating the list of things shown on the Web page.

2. PP 1.2- Add after last sentence: "A panel of three outside modeling experts will be obtained to review the evaluation process."

3. PP 1.5- Add after (PM/TL): "and reviewed by the joint venture team"

4. PP 1.5- Replace the last two sentences with: "The final product will be reports that document the micro-model capabilities and limitations. These reports will have different formats to achieve different objectives. One of the reports will likely be an academic thesis. Another report could be a research/summary report to satisfy the objectives of the HQUSACE funded research which would be directed toward Corps District and Division offices. A third report could be a journal paper to present findings to the civil engineering community."

5. PP 1.6- Adopt change proposed by Andy Gaines regarding the authority to adapt the proposal scope.

6. Table 1.7-2 - Change "Contract data conversion for 15 ...." dollar amount from R&D funds from $52,000 to $14,000. Change bottom line subtotal from $268,000 to $230,000. I was overly optimistic about getting more FY1999 funds this late in year.

7. Table 1.7-2- Change $100,000 to $138,000 under WES and R&D funds. Change bottom line subtotal from $162,000 to $200,000. Tom Pokrefke says we have R&D funds to cover this amount.

4/5 1115 2 1086

4/5 1630 21 335

Fact Sheet **December 11, 1998**

Meeting in St. Louis, MO

Attending:

Doug Kaimen
Phil Combs
Malcolm Dove
Dewey Jones
Claude Strauser
Rob Martin
Dave Gordon
Andy Gaines
Steve Maynord
Charlie Nickles
David Bedenhorn

Subject:

Joint Venture with WES to explore micro-modeling potential and validity.

Established:

Overriding Principles.

1> Joint Team Effort
2> Schedule – has to beet everyone's capabilities.
3> Concentrated Effort to develop Components B & C.
4> Outputs from 3 components must be reviewed by this committee.
5> Andy is Project Manager.
6> Many possibilities for Components B & C.

Clearly Defined Progression During 12 months at Rolla – things MUST keep moving.

KEY PARAMETERS & DATA FROM PREVIOUS STUDIES

1. Initial Flume Tilt/Slope.
2. Final Flume Tilt/Slope.
3. Sediment size and gradation.
4. Maximum flow rate used in the model.
5. Minimum flow rate used in the model.
6. Hydrograph Cycle type (e.g. triangle, sine) and duration.
7. Constant flow rate(s) used for initial model setup and for flow visualization photography.
8. Correlation/Evaluation criteria used for verifying model survey data to prototype data.
9. Number of cycles model operated between repetitive surveys for consistency checks.
10. Number of cycles model operated between alternative runs.
11. Starting conditions for each successive alternative model run.
12. Similitude criteria for flow, sediment transport, time, and surface tension.
13. Water surface elevations for model operation, Maximum and minimum.
14. Shift used for model data conversion to prototype coordinates.
15. Reference coordinates used on Insert.
16. Shift and vertical scales used during initial model setup.
17. Shift and vertical scales used for calibrated model (almost same as #14)
18. Suspended Sediment materials

19. Horizontal scale

20. Min/max size of channels

21. Flow rate

22. Time and budget allowed

23. Sediment Flow through model during cycle operation and at constant flow.

rgaines

From: rgaines [rgaines@umr.edu]
Sent: Thursday, March 09, 2000 1:19 PM
To: 'Davinroy, Robert D MVS'
Subject: RE: Phones

Rob,

Since your phones may be out for a while, I'll try email as a start.

I wanted to discuss with you the following:

1. What does your schedule look like for the rest of the FY and for next FY? We briefly discussed this when I was there on the 26th, but would like your latest rundown.

2. What do you see (want) your role in the evaluation Joint-Venture to be (for this FY and for next FY)?

3. If your workload poses problems with prioritizing any of the evaluation work that we may come up with, is there any way to re-prioritize things to move it up the line?

4. What can be done using any calibrated models you have (e.g. the Vicksburg model) to duplicate some of what will be done on the Kate-Aubrey model? Specifically, if we can calibrate Kate-Aubrey then put in a previous structure plan and "backward" predict what the prototype "should" have looked like. This would be only after all analysis of the functional model(s) was completed.

5. If we can do the above, what would be involved (contacting the sponsoring District, scheduling and prioritizing the work into your schedule, etc., etc.)?

The biggest area is #2...just what you anticipate your role/involvement will be/should be (this may include specific tasks, priorities, schedules, and anything else you want to put down). I haven't really discussed this with you in any detail, and need your thoughts on this). This is important in scheduling out the direction of things as we move forward.

Since E-ACTION is next week, I thought some of these issues might be a good topic for discussion then. I need to talk to MVD to give them an update and will pass along much of this for them to bring up next week.

Anything you can give me, will be beneficial, since we may not get to talk via phone before E-Action.

Andy

-----Original Message-----
From: Davinroy, Robert D MVS
[mailto:Robert.D.Davinroy@mvs02.usace.army.mil]
Sent: Thursday, March 09, 2000 12:56 PM
To: 'rgaines'
Subject: RE: Phones

Our phone lines are down indefinitely, perhaps they will be back up later.

> -----Original Message-----
> From: rgaines [SMTP:rgaines@umr.edu]
> Sent: Thursday, March 09, 2000 12:58 PM
> To: 'Davinroy, Robert D MVS'
> Subject: Phones
>

> Rob,
>
> I've tried to call you a couple of times earlier today, but your and
> Dave's
> lines have been busy. You may be having phone problems but if not would
> you
> please call me when you get off? I've got a couple of items to go over
> with
> you, shouldn't take long. I'll be here till 1:20 and be back after 2:00
> till 2:30. If I haven't heard from you before lab, I'll try again after
> 2:00.
>
>
> Andy Gaines
> email: rgaines@umr.edu
> phone: 573-341-6751

per conversation with Rob 3/13/2000, he sees his role in the evaluation as advisory/review. He doesn't see himself in an active role, but is willing to do some limited work on the Vicksburg model to take it "back in time" like we've doing on the Kate-Aubrey model.

Andy Gaines 3/15/00

MICRO SCALE MOVABLE BED HYDRAULIC MODEL – GUIDELINES AND APPLICATIONS

Roger A. Gaines

Background:

- Recent advances in numerical models still preclude solving complex highly three-dimensional unsteady flow situations with a loose boundary.
- Hydraulic models provide capabilities for replicating complicated flow situations.
- Physical models remain the accepted method for testing the designs for many hydraulic structures
- Historically, physical models required lengthy study times and had relatively high costs
- A decline in physical model use resulted because of high cost and long study times
- Development of small-scale models with movable bed materials provided the potential for cost effective and timely physical model studies
- Further development and acceptance of the small-scale model approach depends on a more complete understanding of the factors affected by scale reduction and scale distortion.
- Review of pertinent literature indicates that similitude criterion for modeling movable bed rivers depends on the approach taken. Similitude criteria generally follows three schools of thought:
    1. Regime "Theory" (e.g. Lacey, Blench)
    2. Rigorous use of mathematical relationships, and
    3. Rational (conditions in model relative to prototype "acceptable")
- Limiting factors stated throughout the literature have little or no documented supporting information

Purpose of Research:

Acceptance of small-scale movable bed models as a useful tool is partly dependent on a basic knowledge of how these models comply with various similitude criteria. Determining which criteria describe those essential processes for establishing "similar" conditions is a fundamental step. The proposed study will furnish part of that basic knowledge by:

- Determining the predominant parameters associated with scale reduction,
- Determining the predominant parameters associated with scale distortion,
- Establishing that these parameters can be accommodated in small-distorted scale models in a way to minimize their negative effects,
- Evaluating the effects of initial starting conditions in the models (given the current methodology), and
- Establishing whether prototype response can be reasonably inferred and predicted from the behavior of the small-scale models

Comparisons between models (various sizes of flumes that "model" other flumes) will likely include Froude, Reynolds, Euler, and Weber Numbers, Shields parameter, hydraulic time scale, sedimentation (morphological) time scale, and bed bathymetry.

Experimentation and Analysis:

- Experiments will be conducted using a series of flow and sediment recirculating flumes. Several flume widths and flow depths will be used to represent various combinations of scale reduction and scale/parameter distortion.

- Experimentation will target identification of those parameters that may limit model minimum scales and/or maximum scale distortions

- Fixed boundary and movable bed cases will be "modeled"

- Effects resulting from Froude, Reynolds and Weber Number distortion (between model and prototype) will be evaluated

- Materials used for bed sediments (both gradation and specific gravity) and river structures (e.g. wire mesh) will be evaluated for determining scale effects. Evaluation will be based on comparative flow patterns, boundary separation zones, and bathymetric surveys.

- Establish fundamental characteristics of light-weight sediment materials as required to analyze scale and distortion effects:
    1. Frictional losses due to particle roughness
    2. Frictional losses due to Bed forms (form roughness)
    3. Material properties of fall velocity, critical bed slope, specific gravity, and gradation for commercially available products

- A single curved flume may be used to evaluate scale and distortion effects that result from channel alignment.

- Methodology to facilitate comparisons of model and prototype bathymetry will be explored. This analysis will likely include one or more of the following: visual inspection of surface contours, surface difference mapping, thalweg mapping, cross-sections, and/or statistical analysis of gridded bathymetric data.

- No computer programming is anticipated for this study; however, some customized applications will be utilized for data analysis.

Summary:

- **In general, opportunities exist for an improved understanding of parameters that govern physical models especially as they pertain to small-scale or small-distorted scale models.**

- The proposed study will provide basic experimental data related to small-scale physical hydraulic models, particularly as developed by the US Army Corps of Engineers

- Establishing the governing parameters for flow and sediment characteristics in the models can be accomplished through a systematic experimental procedure

- Study results can be analyzed using conventional approaches to similitude and dimensional analysis and through standard mathematics.

- Early flume work is anticipated to permit expeditious selection of subsequent runs as the governing parameters become known.

- Extensive research has been performed using movable-bed physical models. Much of that important research focuses on use of larger models.

- Previous investigators have explored similarity considerations in a theoretical framework; however, experimental data supporting selection of key model parameters and identifying their implications relative to model scaling and design are quite limited.

- The proposed research will provide experimental data and an evaluation of key model parameters as they pertain to model scaling (primarily small scales) and model design.

- The proposed study is valuable, bears critical review, and is worthy as a doctoral dissertation.